

# Continuous Glucose Monitoring (CGM)

- ❖ Continuous glucose monitoring is a recent technological advance that provides real-time blood glucose data every one to five minutes, depending upon the model and mode of instrumentation.
- ❖ Data from ongoing clinical trials indicates great potential to improve glycemic control in adults and children with diabetes mellitus by: 1) providing capabilities with the monitoring device to alert the individual of high or low glucose values, and providing treatment to prevent hypo/hyperglycemia; 2) providing a means for real time insulin adjustments based on glucose values that may be rising, falling, or stable; and 3) allowing a retrospective review of glycemic excursions based upon time of day, activity level, and food intake that can be used to refine insulin adjustments.
- ❖ CGM technology is part of a futuristic approach leading to the development of an artificial pancreas that would provide an automated fully closed-loop insulin delivery system that mimics the way a real pancreas would act, by continuously monitoring blood glucose and constantly adjusting the level of insulin needed to keep glucose in an acceptable range.

## What is continuous glucose monitoring (CGM)?

Continuous glucose monitoring is a recent technological advance that utilizes a minimally invasive device connected via a wire to a subcutaneous sensor that can be worn continuously up to 72 hours to monitor interstitial glucose levels, with capabilities to provide real-time blood glucose data every one to five minutes, depending upon the parameters of the model.

Continuous readings obtained create a trend line that can be used to understand how insulin, food, exercise, and other variables affect glucose values. Detailed information about blood glucose fluctuations trends the extent, duration, and frequency of elevations or drops in blood sugars. Data obtained during continuous monitoring highlights the relationships of excursions in blood glucose to certain activities or food, and helps predict or possibly prevent episodes of hypo or hyperglycemia.

## How does the device work?

A small sensor is inserted under the skin via a needle mechanism that measures glucose in the interstitial fluid between the body's cells. This means there is no blood involved. The sensor relays the glucose level to a device that displays the glucose reading, displayed with arrows that show upward or downward trends. The patient can then make adjustments in the insulin to keep glucose at an acceptable range.

## When is continuous glucose monitoring used?

CGM can be utilized as an adjunct to therapy with certain insulin pumps or as a diagnostic tool device to facilitate adjustments in therapy to improve control. Health care providers may utilize CGM in either home or clinical settings for up to 72 hours as an assessment tool to obtain detailed information about blood glucose excursions and fluctuations.

This is accomplished by utilizing the same type of subcutaneous sensor attached to a small computer-like device that downloads and records information regarding blood glucose patterns over the 72-hour period it is worn. The report generated by the device allows the trained healthcare provider to analyze the data along with the patient's records of food intake, activity, medication use, and to monitor adverse events such as hypoglycemia.

Data obtained from this test allows the healthcare provider to make adjustments in drug therapy, support suggested lifestyle modifications, monitor conditions where tighter control without hypoglycemia is needed (gestational diabetes, pediatric patients, and intensive care), and to diagnose and prevent hypoglycemic unawareness, hypoglycemia during sleep, and observe high or low post-prandial readings.

### **What are the potential advantages of CGM?**

Recent clinical trials have indicated that use of continuous glucose monitoring has been associated with decreased time spent in hyper/hypoglycemic ranges, and an increased amount of time spent in a euglycemic range. Both adults and children achieved A1C reductions without additional hypoglycemia. In pediatric patients, use of CGM offers families' new management approaches, the potential for improved glycemic control, and improved quality of life. An added benefit of close monitoring is fewer excursions in glucose levels  $< 70$  mg/dl and  $> 190$  mg/dl, yielding less glycemic instability and fewer swings that necessitate costly visits to the emergency room to treat severe hypoglycemia and DKA. Data can also be used to distinguish between the Dawn and Somogi phenomena. Patients should confirm high or low monitor alarms with a finger stick before any corrective action is taken regarding additional food or insulin, due to the lag time difference between capillary and interstitial sites.

Patients experience better self-management and are able to see a correlation between diet, exercise, and medication and how they affect glucose levels. CGM allows patients to make changes in therapy earlier before preventive actions are not possible.

In actual practice settings, CGM has been implemented in the operating room preceding anesthesia induction, during the time of surgery, and in the post-operative period to reduce periods of hypo/hyperglycemia, decreased infection rates, and increased recovery time in patients with diabetes.

### **Are there disadvantages to CGM?**

There are a number of disadvantages to continuous glucose monitoring and it is not indicated for all patients. Clinical trials are currently ongoing, and at this time clinicians have not yet developed implantation and dissemination tools and algorithms for optimized use and patient selection. Many challenges are involved with how to handle, manage, and trend the voluminous amount of data generated by the monitor without overwhelming both patients and practitioners.

Insulin pump therapy is generally covered by insurance. Due to its novelty, CGM is not always afforded reimbursement, but diagnostic 72-hour CGM through a healthcare provider may be covered by insurance with appropriate justification at time of submission. Costs incurred for transmitters and glucose sensors may be out-of-pocket expenses for patients. Because of the complex nature of the monitoring device, both providers and patients require training in sensor use and trend interpretation.

## **What effect will CGM have on the future of diabetes care?**

Futuristic trends in diabetes technology would be the eventual development of an automated fully closed-loop insulin delivery system that would regulate blood sugar like the beta cells within the pancreas, i.e. an “artificial pancreas.” A limitation in the development of the artificial pancreas has been related to the lack of robust continuous glucose monitoring capabilities and mature control algorithms that are capable of driving the insulin delivery system.

Currently, the FDA has approved five continuous glucose monitoring devices, and a sixth is in the final stages of clinical trials. Great potential exists for improved glycemic control in adults and children with diabetes to enhance quality of life, increase management flexibility, and reduce the complications related to diabetes mellitus.

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